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A Machine for Controlling Loose Smut in Wheat and Barley

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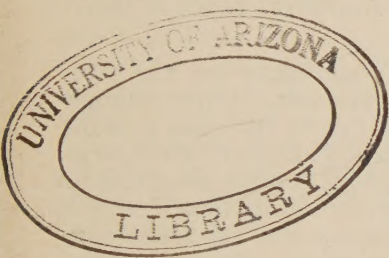
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Progressive stages in the destruction of wheat heads by loose smut. At the left is a healthy head for comparison.



A MACHINE FOR CONTROLLING LOOSE SMUT IN WHEAT AND BARLEY

By K. Starr Chester

Loose smut of wheat (*Ustilago tritici* (Pers.) Rostr.) appears to be of slowly but steadily increasing importance in the Southwest. In 1939 the disease was unusually prevalent in Texas, Oklahoma, and Kansas.* Field counts of 10 percent infestation were not uncommon, and counts as high as 25 percent were occasionally obtained.

Field specialists recognize a tendency on the part of growers to under-evaluate the importance of losses from loose smut. At least two factors are responsible for this apathy. On the one hand, loose smut, even in relatively high percentage, is inconspicuous at harvest time. On the other hand, the losses from loose smut are field losses; the harvested grain is uninjured in quality.

The elevator operator is largely responsible for the attitude of the grower respecting wheat diseases. When disease affects the market quality of the grain, as in the case of bunt or scab, the elevator operator is concerned and is often instrumental in encouraging the grower to adopt control practices or even in undertaking to aid him by seed-treatments at the elevator, on a service basis.** When diseases are apparent only in the field, they are under-evaluated by the elevator operator; and his attitude in turn conditions that of the grower. However, the losses from loose smut in 1939 were so evident that numerous growers began investigating the possibility of preventive measures. In one progressive community in Oklahoma, for example, 100 growers undertook a program for seed treatment which should virtually eliminate the disease from that community in two years.

Programs for loose smut control are handicapped by the fact that the hot-water seed treatment, which is the only preventive measure generally recommended at present, is slow and difficult, and requires great care if seed injury is to be avoided.

*Atkins, I. M., 1939. Rusts and loose smut on small grains in Texas. U. S. Dept. Agr., Plant Disease Reporter 23:149.

Chester, K. Starr, 1939. Wheat diseases in Oklahoma. U. S. Dept. Agr., Plant Disease Reporter 23:198.

Johnston, C. O., 1939. Wheat diseases in Kansas. U. S. Dept. Agr., Plant Disease Reporter 23:198.

**Anonymous, 1938. Seed conditioning plant features Oklahoma elevator. Grain and Feed Journals Consolidated 80:72.

The grower who attempts to treat his own seed is in danger of failure because of inexperience with the precision required. He is likely to lack appreciation of the importance of such details as an accurately calibrated thermometer and rapid drying of the treated seed.

On the whole, it has been found most satisfactory to carry out the hot-water treatment on a community basis, under the supervision of an agricultural specialist. This plan has two advantages. First, it permits the treatment to be accomplished under the safest and most economical conditions. Second, it renders the treatment more effective, because when larger acreages are planted with treated seed there is less danger of contamination of healthy wheat by the air-borne smut spores from adjacent infested fields.

MACHINE MAKES SEED TREATMENT EASIER AND MORE EFFECTIVE

In community treatment of seed for loose smut, it is often the practice to secure the equipment required by using the facilities of a laundry or creamery, where steam, water, and vats are available, or to improvise the equipment, for example, by using a portable steam boiler and stock-watering troughs. Such equipment is always inconvenient, and the difficulty of securing accurate control with improvised equipment may result either in damage to the seed or in failure to secure complete control of the smut.

To meet the need for a convenient, inexpensive and effective community seed treatment for loose smut control, a portable hot-water seed treater has been designed at the Oklahoma Agricultural Experiment Station. An operating model built to 2/5 scale has been tested and promises to contribute to filling this need.

The principles involved are not new. Tests by the federal department of agriculture and by numerous state experiment stations* have shown that loose smut may be effectively prevented by soaking the seed wheat for 10 minutes in water at 129 degrees.** Both time and temperature must be precisely controlled. If the temperature rises above 130 degrees, or if the time of treatment is increased, seed injury results; while if the temperature falls below 128 degrees the seed are not disinfested.

*Leukel, R. W. et al. 1938. Wheat smuts and their control. U. S. Dept. Agr. Farm. Bull. 1711, rev.

**All temperatures in this bulletin are given in degrees Fahrenheit.

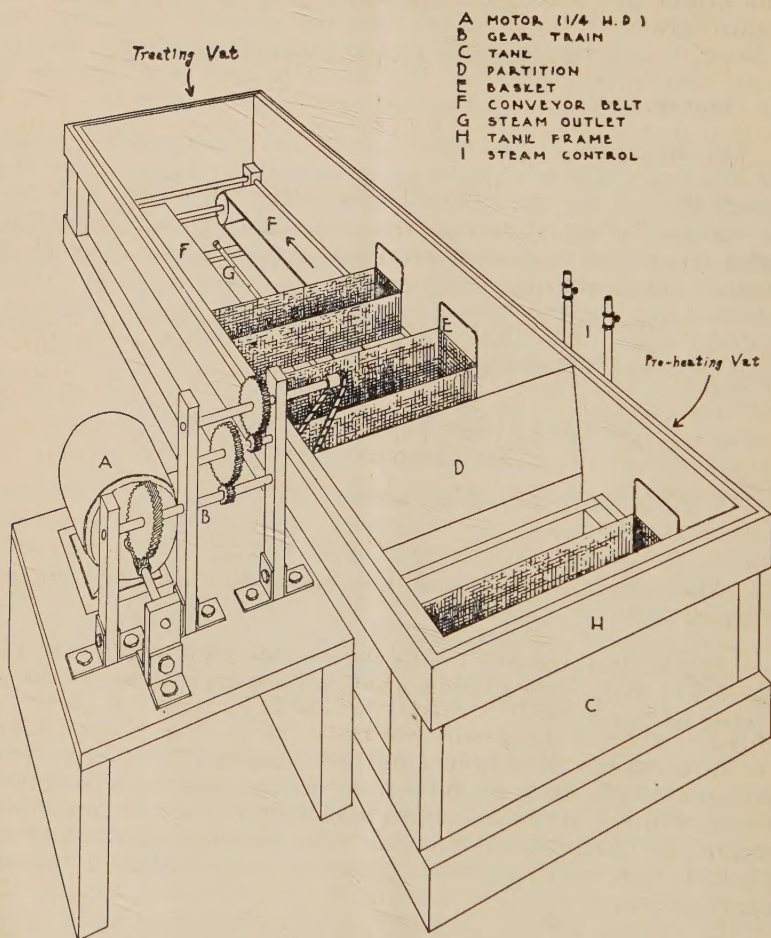


Figure 1. Working sketch of hot water seed treater for loose smut control.

The principal advantages of a machine of the type herein described are:

The time of treatment is automatically controlled.

The temperature is controlled by a semi-automatic device, so that in actual practice the error rarely if ever exceeds one-half the margin of safety.

It permits a more even and rapid penetration of heat.

It may be easily carried from one locality to another on a farm truck, and operated wherever there is a supply of water, steam, and electricity.

It is not customary to attempt to treat all seed for a wheat acreage. Instead, only enough is treated to plant a separate seed plot. The wheat harvested from the seed plot is used the following season to plant the main acreage. A full sized machine of this type has the capacity of treating 500 bushels of seed per day, and this corresponds to a smut-free acreage the following year of five thousand to ten thousand acres.

CONSTRUCTION OF THE MACHINE

The construction of the machine is illustrated in Figures 1 and 2.

In Figure 1, the gear train (B) consists of a worm gear with a ratio of 100:1 and further gears producing a total reduction, from motor (A) to drive shaft, of 1750 R. P. M. to 1 R. P. M. At this rate the 4" rubber conveyor belts (F) move at a speed which requires exactly 10 minutes for the baskets (E) to move from one end of the tank to the other. In the position of Figure 1, the movement of the baskets is toward the rear, i. e., toward the top in the illustration. The partition (D) is double walled and packed with mineral wool. It serves to separate the larger tank, in which the temperature is maintained at exactly 129° in the case of wheat, from the smaller preheating tank, which contains water at approximately 120°. The water is heated by free steam, bubbling through 1/16" jets in the three pipes (G) controlled by valves at (I). The tank (C) is constructed of galvanized iron, braced by a frame of 2"x4" wooden joists (H). The seed baskets (E) are constructed of galvanized screen wire, reinforced by rigid wire rods. The temperatures are controlled by reference to a floating thermometer in each bath. Inexpensive dairy thermometers may be used, but it is preferable to use better grade technical thermometers supported by insertion in large floating corks. In either case, the thermometers before being used should be compared with a standard thermometer known to be accurate to laboratory standards.

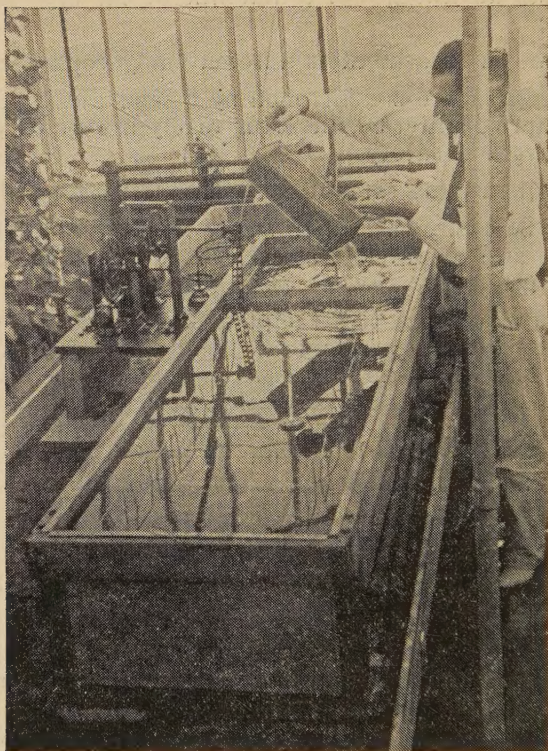


Figure 2. Photograph of model seed treater, $2/5$ full size, used for demonstration and for treating Experiment Station seed grain.

The model shown in Figure 2 is 40% of the full-sized machine, which treats one bushel of wheat per minute. In the model, the larger tank is 2'x5'x16" high, the smaller tank 2' square, and the baskets 15"x5"x4 $\frac{1}{2}$ " high, exclusive of the handles. In the full-sized machine each of these dimensions is to be multiplied by 2.5. The model was constructed for testing and demonstration and for practical use at the Oklahoma Agricultural Experiment Station, where seed is usually planted in 4 lb. lots.

The machine can be operated by two men in addition to the farmer being served. The principal operator transfers the seed baskets from the preheating vat to the heating vat, removes the treated seed, aids in sacking it, and takes charge of the steam valves and thermometers. His assistant prepares the baskets

of seed and keeps one continually in the preheating bath. The farmer unloads the sacks of seed to be treated, and sacks and loads the treated seed. It is the farmer's responsibility to soak the sacks of seed for four hours before bringing them to the treater, and to spread out and dry the seed as soon as possible after the treatment. If this cannot be done in the vicinity of the machine, a tank of cold water must be provided for cooling the baskets of seed after removal from the warm tank.

COST OF TREATMENT

The cost of construction of one machine is estimated at a maximum of \$200, although this could doubtless be reduced in the construction of several machines. If this is amortized over seven years and the machine operates at capacity twenty days in the year, the cost of operation would be approximately:

	<i>Per day</i>
Maintenance, storage and depreciation of machine -----	\$ 3.50
Labor and subsistence of operators -----	11.00
Steam, electricity, water -----	1.00
Connecting steam line -----	2.00
Transportation of machine -----	2.00
	\$19.50

Cost per bushel $\$19.50 \div 500 = 3.9\text{¢}$ exclusive of farmers' time in delivering and drying seed.

USE OF MACHINE

Although the heat treatment is a preventative against both bunt (covered or stinking smut) and loose smut, it is recommended that the heat-treated seed be subsequently dusted with an organic mercury dust such as "New Improved Ceresan" to protect against soil-borne infections, and that the seed plot be removed as far as practical from any large wheat acreage, preferably on the side in the direction of the prevailing winds.

The machine is suitable for treating either wheat or barley for loose smut. In the case of barley the treatment is at 126 degrees for 13 minutes, and this necessitates substituting a slightly larger gear wheel on the end of the drive shaft at the lower end of the sprocket chain. It should be borne in mind that there are two types of loose smut as well as covered smut in barley. The covered smut and the black loose smut are controlled by dusting the barley seed with disinfectant chemicals.

The brown loose smut may be controlled only by the hot water treatment. A program of seed dusting may largely eliminate the smuts from barley, but the hot water treatment is desirable for a complete eradication program and in communities where the brown loose smut is prevalent.

In the much-needed extension of loose-smut control programs the treater may be recommended either as a community investment or as a portable unit, servicing a number of communities at a nominal cost. As a community investment, the first cost is very low as compared with other agricultural equipment, and this cost will be repaid through small service charges, not necessarily greater than 5¢ per bushel of seed treated. As a portable unit, it may be operated and moved at the rate of a community per day. In such a case the work might be undertaken either as an agricultural extension or vocational agriculture project on a self-supporting basis, or as a private venture. Cereal seed-dusting programs have been successfully carried out in both of these ways, although the original cost and the operation expense of dusting equipment are often higher than the cost of the hot-water treatment as outlined above.